



A Human Error Perspective of Safety Planning and Control

Tarcisio A. Saurin, Carlos T. Formoso and
Fabricio B. Cambraia

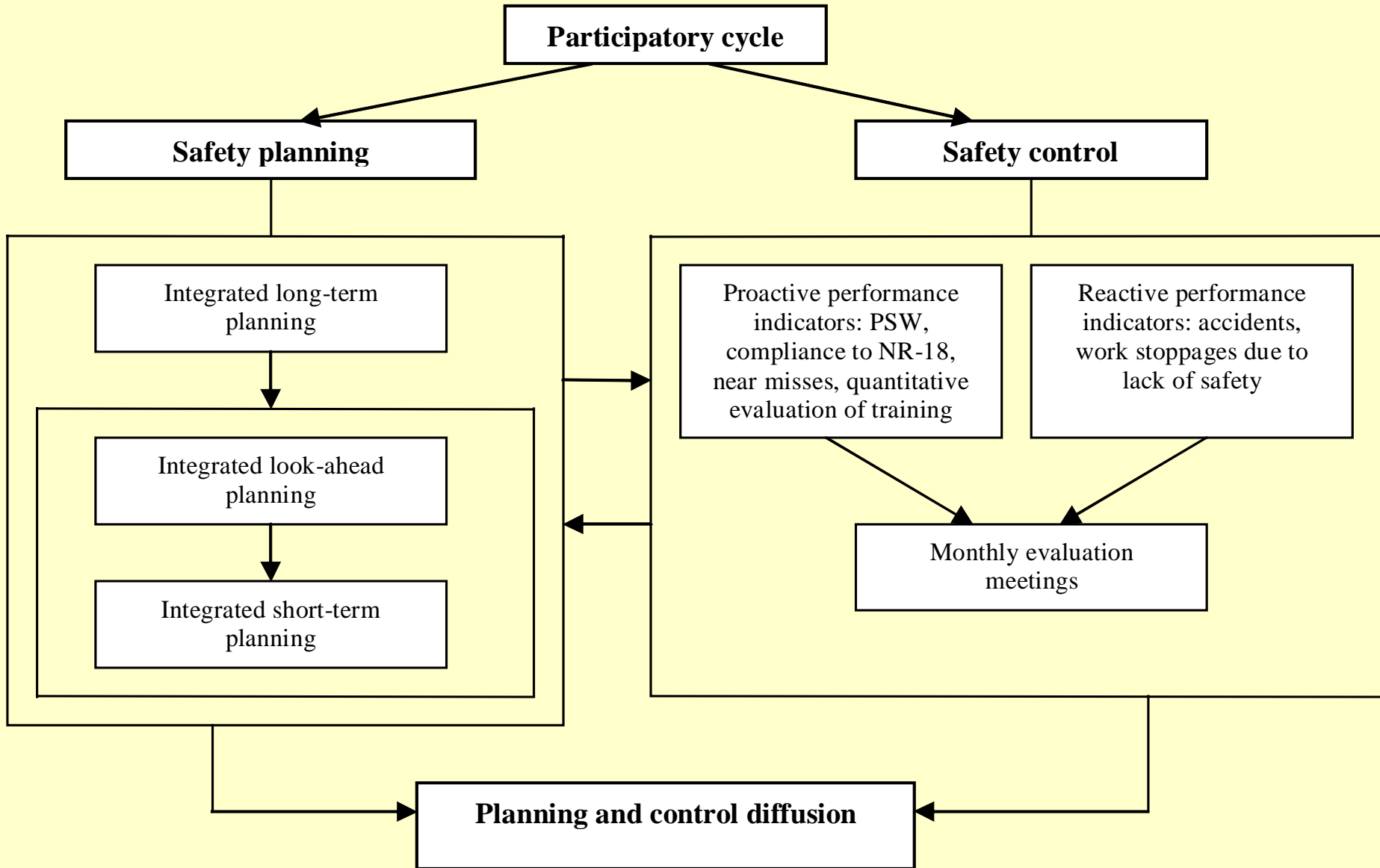
Porto Alegre – RS, Brazil



Introduction

- ❑ The Safety Planning and Control (SPC) model has been presented in previous conferences (IGLC9 and IGLC10)
- ❑ Focus on the integration of safety management and production planning & control, using the Last Planner System as a reference
- ❑ Some safety best practices pointed out in the literature are also part of the model (e.g. pre-task planning, work-force participation, performance measurement,

Overview of the Safety Planning and Control (SPC) model





PSW (Percentage of Safe Work Packages)

$$\text{PSW} = \frac{\sum \text{number of safe work packages}}{\sum \text{total number of work packages}}$$

- What is a safe work package ?
 - No failure in the conception of safety plans has been detected
 - There has been no failure in plans implementation
 - No accidents or near misses have happened



Example of form used to collect data for PSW

Site: Steel mill refurbishment		Observer: Diego		Date: 10/05/01	
Observation period: 10h to 12h			Safe?		
Gang	Work packages	PHA n°	Yes	No	Problem
BSF	Walls from column 25 to 28	PHA 2	X		
SH	Change roof from column 5 to 7	PHA 5		X	Body harness badly tied
	Activities not clearly associated to work packages				
BSF	Common circulation areas	PHA 8	X		
BSF	Formwork shop	PHA 6	X		

Observation x Two-way feedback





Aim of the paper

- ❑ **Discuss the impact of the SPC model on human error, based on data collected in four construction sites**
 - ❑ Human error is a major contributing factor in accident causation
 - ❑ Current best practices have been ineffective to deal with human errors
 - ❑ By understanding the limitations of the model regarding human error control, it will be possible to identify other accident preventive measures



Causes of safety failures

W = workers

M = managers

	Site A	Site B	Site C	Site D
<i>Planning and control failures</i>	51,6%	51,4%	66,7%	35,4%
<i>Non-intentional errors (workers)</i>	0,0%	0,0%	2,2%	0,0%
<i>Non-intentional errors (mgment.)</i>	2,2%	1,7%	5,9%	1,3%
<i>Violations (workers)</i>	16,5%	27,8%	12,6%	54,7%
<i>Violations (mgment.)</i>	9,9%	19,1%	12,6%	8,6%
<i>Client interferences</i>	19,8%	0,0%	0,0%	0,0%
<i>Total</i>	100%	100%	100%	100%



Examples of failures

- **Planning and control**
 - Interference among crews,
 - Non-identified risks
 - Failures in methods planning
- **Non-intentional errors (workers)**
 - Poor communication among crew members
- **Non-intentional errors (managers)**
 - Ineffective training



Examples of failures

- Violations (workers)
 - Imprudent operation of equipment, lack of PPE use
- Violations (managers)
 - Lack of safeguards implementation or maintenance



Drawbacks of the failure analysis

- **Some of the violations are immediate causes rather than root causes**
- **Some of the violations may happen simultaneously to non-intentional errors or planning and control failures**
- **A failure may sometimes be classified as a violation for the lack of further information**
 - **The causes were assigned though a consensus between the researchers and the safety specialist**
 - **Workers' perceptions were taken into account**



Strategies for improving performance at the boundary of loss of control (Rasmussen et al., 1994)

- **Ensure the visibility of boundaries beyond which work is no longer safe**
- **Make the production system error tolerant (e.g. poka yokes)**
- **Ensure that the boundaries are respected**



Contribution of the model for the reduction of human errors

	To ensure visibility of boundaries	To make the production system error-tolerant	To ensure that boundaries are respected
Safety planning	X	X	X
Near miss reporting	X		X
Training sessions	X		X
PSW indicator	X		X
Participatory cycle	X		X
Planning and control diffusion	X		X





Conclusions

- **PSW and near miss reporting were very useful tools to identify the most frequent types of human errors**
- **Data indicated a high incidence of violations (40% of the total failures), mostly by workers**
- **A broader set of measures is necessary to achieve excellence in dealing with human errors and, in particular, violations**
- **Additional research is necessary to clarify the frequency and the underlying causes of the different types of human errors in construction**